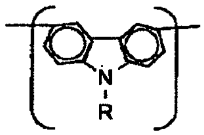

CLAIMS

[Claim(s)]
[Claim 1]It is formed between a positive electrode layer and a two-electrodes layer of catholyte, and said electron hole transporting bed in an organic electroluminescence element which has an electron hole transporting bed and a luminous layer, [Chemical formula 1]

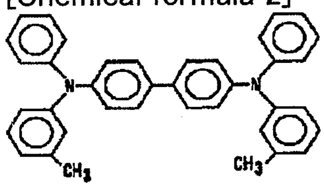


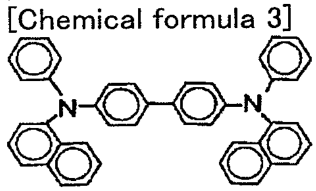
(R shows hydrogen, an aliphatic hydrocarbon group, an aromatic hydrocarbon group, an ether group, or a heterocycle group among a general formula [the-izing 1].)
An organic electroluminescence element comprising a polymer which has a repeating unit expressed with a general formula [the-izing 1].
[Claim 2]The organic electroluminescence element according to claim 1, wherein said polymer comprises a copolymer which has a repeating unit expressed above [the-izing 1].
[Claim 3]The organic electroluminescence element according to claim 1 or 2, wherein R in a repeating unit expressed above [the-izing 1] comprises a with a carbon number of ten or less alkyl group.
[Claim 4]The organic electroluminescence element according to claim 1 or 2, wherein R in a repeating unit expressed above [the-izing 1] comprises a with a carbon number of ten or less alkoxyl group.
[Claim 5]The organic electroluminescence element according to claim 1 or 2, wherein R in a repeating unit expressed above [the-izing 1] comprises a substituent which has an aryl group.
[Claim 6]An organic electroluminescence element given in any 1 clause of Claims 1-5 characterized by choosing a substituent expressed as R during the above [the-izing 1], or a molecular weight of said polymer so that it may be meltable to a solvent in which a luminescent substance which constitutes said luminous layer makes said polymer insoluble.
[Claim 7]In order for below 10.0$(cal/cm^3)^{1/2}$ to carry out, more than 8.9$(cal/cm^3)^{1/2}$ a solubility parameter range in a room temperature of said polymer said solvent, . In more than 7.0$(cal/cm^3)^{1/2}$, a solubility parameter in a room temperature belongs to the range of less than 8.9$(cal/cm^3)^{1/2}$. N-pentane, hexane, heptane, n-octane, n-nonane, n-Deccan, The organic electroluminescence element according to claim 6 comprising either 1-decene, a methylcyclohexane, cyclohexane, 1-chloropropane, tetrachloromethane, ethylbenzene or m-xylene.
[Claim 8]In order for below 10.0$(cal/cm^3)^{1/2}$ to carry out, more than 8.9$(cal/cm^3)^{1/2}$ a solubility parameter range in a room temperature of said polymer said solvent, . A solubility parameter in a room temperature belongs to a range below 13.0$(cal/cm^3)^{1/2}$ more greatly than 10.0$(cal/cm^3)^{1/2}$. The organic electroluminescence element according to claim 6 comprising either alpha bromonaphthalene, nitroethane, acetonitrile or nitromethane.
[Claim 9]An organic electroluminescence element given in any 1 clause of Claims 1-8, wherein

said luminous layer has the dopant which emits phosphorescence.

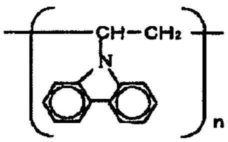
[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the organic electroluminescence element which can emit light for high-intensity.
[0002]
[Description of the Prior Art]As an organic electroluminescence element of the multilayer laminated structure aiming at raising luminous efficiency conventionally, it is formed between a positive electrode layer and the two-electrodes layer of catholyte, and what has an electron hole transporting bed and a luminous layer is known. As the hole-transport substance which constitutes an electron hole transporting bed in this thing, [0003]
[Chemical formula 2]


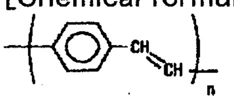
[0004]It is common to use hole-transport low molecules, such as N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl 4,4'-diamine (henceforth [TPD]) shown in [the-izing 2].
[0005]As a light-emitting method of the above-mentioned conventional organic electroluminescence element, if luminescence from an excitation triplet state, i.e., phosphorescence, is used, the quantum efficiency of luminescence can be raised. To the theoretical limit of the internal quantum efficiency in the case of making light emit using luminescence by an excitation singlet state, i.e., fluorescence, being 25%, luminescence by phosphorescence may consider the theoretical limit of internal quantum efficiency to be 100%, in order that the excitation energy of a triplet state may contribute to luminescence. For this reason, improvement in the luminous efficiency defined by the light emitting luminance to driver voltage is expectable.
[0006]
[Problem to be solved by the invention]In the case of luminescence according to phosphorescence at this time [0007]
[Chemical formula 3]


[0008]hole-transport low molecules, such as N,N'-diphenyl-N,N'-bis(1-naphthyl)-1,1'-biphenyl 4,4'-diamine (henceforth the following) shown in [the-izing 3], -- or [0009]
[Chemical formula 4]

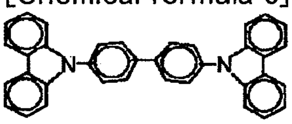


[0010]The electric resistance value correlated with hole mobility, such as hole-transport polymers, such as poly (N-vinylcarbazole) (henceforth [PVK]) shown in [the-izing 4], uses the high hole-transport substance relatively.
[0011]Therefore, in making the organic electroluminescence element which emits light by phosphorescence using the above NPD and PVK as a hole-transport substance drive, comparatively high impressed electromotive force is needed, and this becomes a factor which checks improvement in expected luminous efficiency.
[0012]In view of the above-mentioned problem, this invention may emit light with high-intensity by drive by the low voltage, namely, makes it SUBJECT to provide an organic electroluminescence element with high luminous efficiency.
[0013]
[Means for solving problem]In order to solve an aforementioned problem, this invention is formed between a positive electrode layer and the two-electrodes layer of catholyte, and consists of polymers which have a repeating unit expressed with [the-izing 1] in said electron hole transporting bed in the organic electroluminescence element which has an electron hole transporting bed and a luminous layer. Since such a polymer is a conductive polymer which has a carbazole group in a main chain, it has high hole mobility. For this reason, an electron hole can move to a luminous layer certainly from an electron hole transporting bed.
[0014]In this case, said polymer can also comprise the copolymer which has a repeating unit expressed above [the-izing 1].
[0015]As for R in the repeating unit expressed above [the-izing 1] in these cases, it is desirable to comprise a with a carbon number of ten or less alkyl group.
[0016]As for R in the repeating unit expressed above [the-izing 1], it is desirable to comprise a with a carbon number of ten or less alkoxyl group.
[0017]As for R in the repeating unit expressed above [the-izing 1], it is desirable to comprise the substituent which has an aryl group.
[0018]The substituent expressed as R during the above [the-izing 1] or the molecular weight of said polymer is chosen, and if it is made to be soluble, the above-mentioned organic electroluminescence element can be formed in the solvent in which the luminescent substance which constitutes said luminous layer makes said polymer insoluble with wet process.
[0019]In this case, in order for below $10.0(cal/cm^3)^{1/2}$ to carry out [more than $8.9(cal/cm^3)^{1/2}$] the solubility parameter range [in / for convenience / the room temperature of said polymer] of selection of the solvent used with wet process, . In more than $7.0(cal/cm^3)^{1/2}$, as a solvent which makes said polymer insoluble, the solubility parameter in a room temperature belongs to the range of less than $8.9(cal/cm^3)^{1/2}$. N-pentane, hexane, heptane, n-octane, n-nonane, n-Deccan, 1-decene, a methylcyclohexane, cyclohexane, 1-chloropropane, tetrachloromethane, ethylbenzene, or m-xylene can be used.
[0020]Similarly, in order for below $10.0(cal/cm^3)^{1/2}$ to carry out [more than $8.9(cal/cm^3)^{1/2}$], the solubility parameter range in the room temperature of said polymer, . As a solvent which makes said polymer insoluble, the solubility parameter in a room temperature belongs to the range below $13.0(cal/cm^3)^{1/2}$ more greatly than $10.0(cal/cm^3)^{1/2}$. alpha bromonaphthalene, nitroethane, acetonitrile, or nitromethane can be used.
[0021]It is desirable for said luminous layer to have the dopant which emits phosphorescence in these cases. If it does in this way, formation of the organic electroluminescence element which may emit light by phosphorescence will be attained.
[0022]
[Mode for carrying out the invention]Drawing 1 shows the basic structure of the organic electroluminescence element which has the element structure laminated by the multilayer for

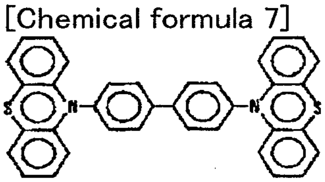
the purpose of improvement in luminous efficiency. The element structure of an organic electroluminescence element, To the positive electrode layer 10 formed on the substrate besides a figure, each thin film layer of the electron hole transporting bed 20, the electron block layer 30, the luminous layer 40, the hole block layer 50, and the electron transport layer 60, It is a multilayer laminated structure which is laminated one by one and changes between the two-electrodes layers of the positive electrode layer 10 and the catholyte 70, and the luminous layer 40 has the luminous layer dopant 41 and the luminous layer host agent 42, and is constituted.
[0023]In the element structure shown, by drawing 1, the positive electrode layer 10, For example, the transparent conductive substance formed in a transparent insulating support body like a glass substrate is used, and as the material, Conductive polymers, such as inorganic conductive substances, such as metal, such as conductive oxides, such as tin oxide, indium oxide, and tin oxide indium (ITO), or gold, silver, and chromium, iodine copper, and copper sulfide, a polythiophene, polypyrrole, and poly aniline, etc. can be used.
[0024]When the catholyte 70 is formed with a transparent material, the positive electrode layer 10 may be formed with an opaque material.
[0025]In the element structure shown by drawing 1, a simple substance or alloys, such as lithium, sodium, potassium, a rubidium, caesium, magnesium, calcium, strontium, barium, boron, aluminum, copper, silver, and gold, can be used for the catholyte 70. These can also be laminated and used. It can also form by a wet type by a tetrahydro aluminate. In this case, especially as a tetrahydro aluminate used for the catholyte 70, lithium aluminum hydride, hydrogenation aluminum potassium, hydrogenation aluminum magnesium, and hydrogenation aluminum calcium can be mentioned. In this, lithium aluminum hydride is excellent in especially the electron injection nature to an electron transport layer.
[0026]The electron hole transporting bed 20 is a layer for conveying the electron hole poured in from the positive electrode layer 10, and is an organic layer containing a hole-transport organic matter. NPD shown in [the-izing 3] as an example of an electron hole transporting bed nature organic matter, PVK shown in [the-izing 4], [0027]
[Chemical formula 5]



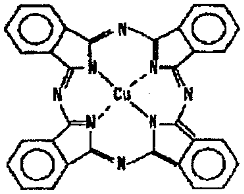
[0028]It is preferred to consist of polymers, such as poly (****- phenylenevinylene) shown in [the-izing 5]. Or TPD shown in [the-izing 2], [0029]
[Chemical formula 6]

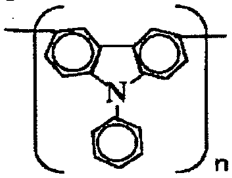


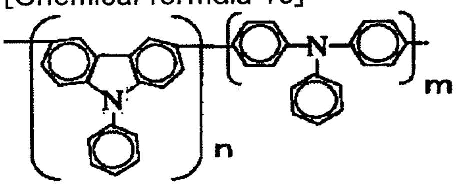
[0030]Carbazole biphenyl shown in [the-izing 6] (henceforth CBP), [0031]
[Chemical formula 7]

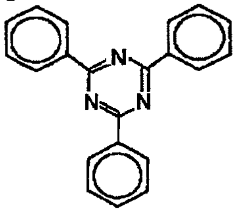


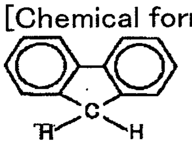
[0032]4,4'-bis(10-phenothiazinyl)biphenyl shown in [the-izing 7], [0033]
[Chemical formula 8]



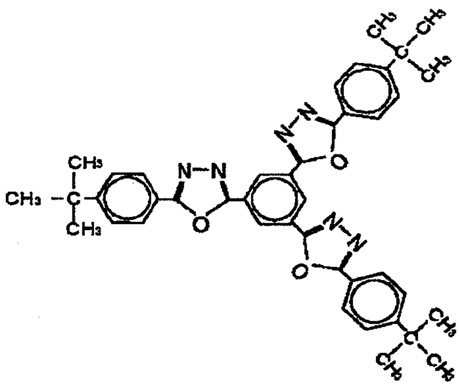
[0034]the following which has the kappa phthalocyanine shown in [the-izing 8], and the repeating unit which made the phenyl group R in a general formula [the-izing 1] -- the poly carbazole compound shown by [the-izing 9] and the [-izing 10], [0035]
[Chemical formula 9]


[0036]
[Chemical formula 10]


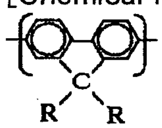
[0037]([the-izing 10] -- inside, and m and n -- m= 2 n -- the natural number which has a relation is shown.) etc. -- it is mentioned.
[0038]The electron block layer 30 is a layer for blocking an electron, in order that the electron poured in to the luminous layer 40 may protect passing to the positive electrode layer 10 as it is from the catholyte 70, and it comprises an electronic block nature substance. The compound shown by the [-izing 2] thru/or the [-izing 7] as an electronic block nature substance, for example, [0039]
[Chemical formula 11]


[0040]2,4,6-triphenyl-1,3,5-triazole shown in [the-izing 11], [0041]
[Chemical formula 12]


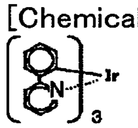
[0042]FUROREN etc. which are shown in [the-izing 12] can be mentioned.
[0043]Since the luminous layer 40 has the dopant 41 and the host agent 42 and these dopants 41 and the host agent 42 are distributed uniformly, it is also possible to add a binder polymer. CBP which it is a substance which activation is carried out and acts as an exciton when the electron hole and electron which were poured in, respectively recombine the host agent 42 in the luminous layer 40 from the positive electrode layer 10 and the catholyte 70, and is shown in [the-izing 6], [0044]
[Chemical formula 13]



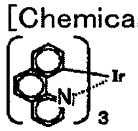
[0045]1,3,5-bird (5-(4-tert-buthylphenyl)-1,3,4-oxadiazole) phenyl (OXD-1 is said below.) shown in [the-izing 13]
[0046]
[Chemical formula 14]



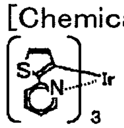
[0047](R shows hydrogen, an aliphatic hydrocarbon group, an aromatic hydrocarbon group, an ether group, or a heterocycle group among a general formula [the-izing 14].)
The Polyful Oren compound etc. which have a general formula [the-izing 14] as a repeating unit are mentioned.
[0048]On the other hand, the dopant 41 of the luminous layer 40 is a substance which emits phosphorescence with the excitation energy of the exciton slack host agent 42, [0049]
[Chemical formula 15]



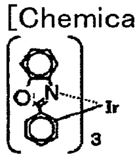
[0050]The bird (2 phenylpyridine) iridium complex shown in [the-izing 15] (Ir(ppy) $_3$ is said below.), [0051]
[Chemical formula 16]



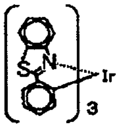
[0052]
[Chemical formula 17]



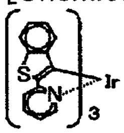
[0053]
[Chemical formula 18]



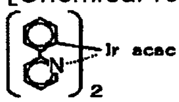
[0054]
[Chemical formula 19]



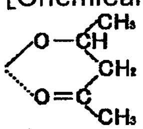
[0055]
[Chemical formula 20]



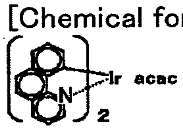
[0056]
[Chemical formula 21]



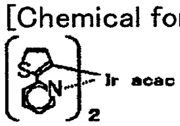
[0057](Inside of a chemical formula [the-izing 21], and acac) [0058]
[Chemical formula 22]



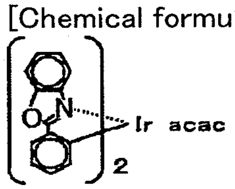
[0059]A functional group shown by [the-izing 22] is shown. the following -- the same in a chemical formula shown in the [-izing 23] thru/or the [-izing 27].
[0060]
[Chemical formula 23]



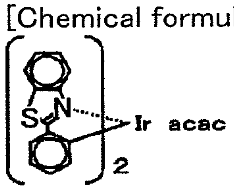
[0061]
[Chemical formula 24]



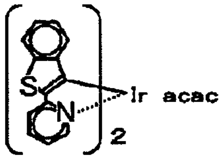
[0062]
[Chemical formula 25]



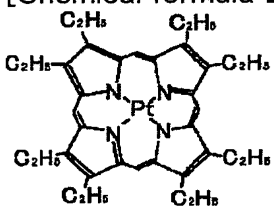
[0063]
[Chemical formula 26]



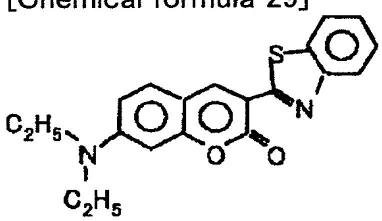
[0064]
[Chemical formula 27]



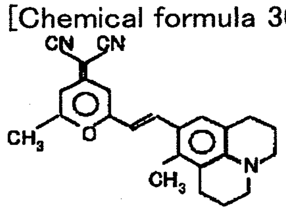
[0065]The [-izing 16] Or an iridium complex compound shown by [the-izing 21], the [-izing 23], or the [-izing 27], [0066]
[Chemical formula 28]



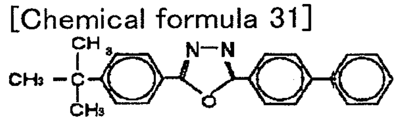
[0067]2,3,7,8,12,13,17,18-octaethyl-21 H,23H-platinum (II) porphin shown in [the-izing 28] (henceforth the following), [0068]
[Chemical formula 29]



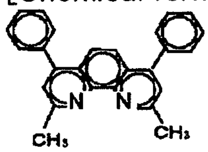
[0069]The 3-(2'-benzothiazolyl)-7-diethylamino coumarin shown in [the-izing 29] (henceforth the coumarin 6), [0070]
[Chemical formula 30]

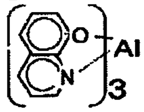


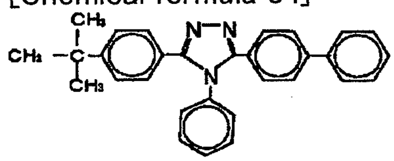
[0071]The propane-dinitrile (DCM2 is said below.) etc. which are shown in [the-izing 30] (2-methyl-6-(2-(2,3,6,7-tetrahydro 1H, 5H-benzo (ij) KUINO lysine 9-yl) ethynyl)-4H-pyrane-4-ylidene) can be mentioned.
[0072]As an example of the binder polymer which can be added to the luminous layer 40, polystyrene, Polyvinyl biphenyl, polyvinyl phenanthrene, polyvinyl anthracene, Polyvinyl perylene, poly (ethylene-co-vinyl acetate), cis of polybutadiene, trans, poly (2-vinylnaphthalene), A polyvinyl pyrrolidone, polystyrene, poly (methyl methacrylate), Poly (vinyl acetate), poly (2-vinylpyridine co-styrene), A polyacenaphthylene, poly (acrylonitrile co-butadiene), poly (benzyl methacrylate), poly (vinyltoluene), poly (styrene co-acrylonitrile), poly (4-vinylbiphenyl), a polyethylene glycol, etc. are mentioned.
[0073]The hole block layer 50 is a layer for blocking an electron hole, in order that the electron hole poured in to the luminous layer 40 may protect passing to the catholyte 70 as it is from the positive electrode layer 10, and it comprises an electron hole block nature substance. OXD-1 shown in [the-izing 13] as an electron hole block nature substance, for example, [0074]
[Chemical formula 31]

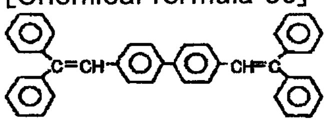


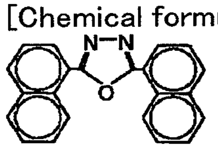
[0075]2-(4-biphenylyl)-5-(4-tert-buthylphenyl)-1 shown in [the-izing 31], 3, and 4-oxadiazole --

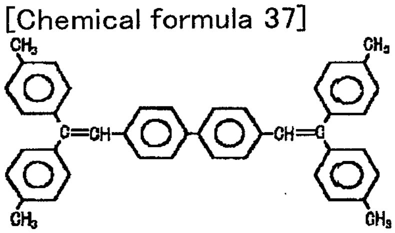
(-- it is also called the following PBD.) [0076]
[Chemical formula 32]


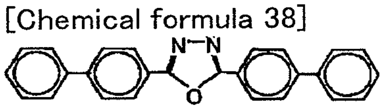
[0077]BASOKYU pro yne shown in [the-izing 32] (henceforth [BCP]), [0078]
[Chemical formula 33]


[0079]Tris(8-hydroxyquinolinate)aluminium shown in [the-izing 33] (Alq3 is said below.), [0080]
[Chemical formula 34]


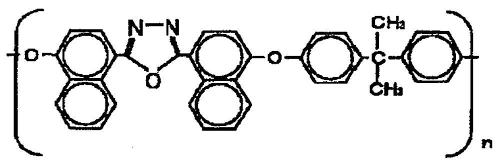
[0081]3-(4-biphenylyl)-5-(4-tert-buthylphenyl)-4-phenyl-1,2,4-triazole shown in [the-izing 34] (henceforth TAZ), [0082]
[Chemical formula 35]


[0083]4,4'-bis(1,1-diphenylethenyl)biphenyl shown in [the-izing 35] (DPVBi is also told to below.), [0084]
[Chemical formula 36]


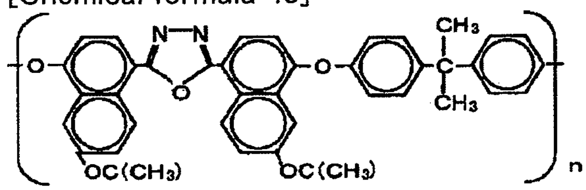
[0085]2,5-bis(1-naphthyl)-1.3.4-oxadiazole shown in [the-izing 36] (BND is also told to below.) [0086]
[Chemical formula 37]


[0087]4,4'-bis(1,1-bis(4-methylphenyl)ethenyl)biphenyl shown in [the-izing 37] (henceforth the following), [0088]
[Chemical formula 38]


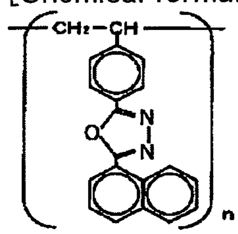
[0089]2,5-bis(4-biphenylyl)-1 shown in [the-izing 38], 3, 4-oxadiazole (henceforth [BBD]), [0090]
[Chemical formula 39]



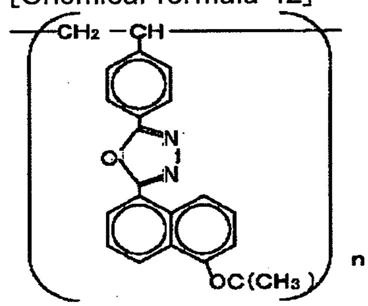
[0091]
[Chemical formula 40]



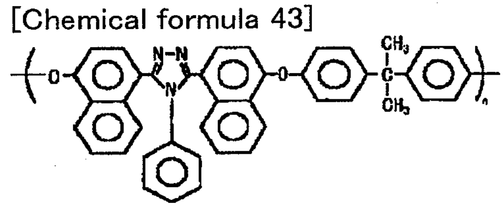
[0092]
[Chemical formula 41]



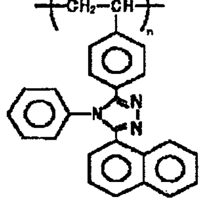
[0093]
[Chemical formula 42]

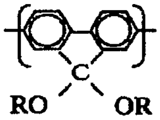


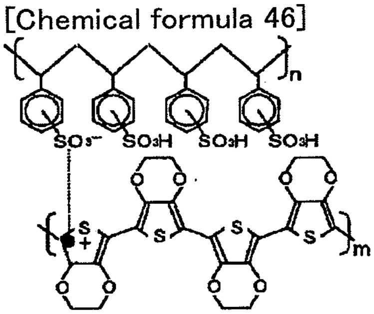
[0094][-izing 39] Or oxadiazole system high molecular compound as shown in [the-izing 42],
[0095]
[Chemical formula 43]



[0096]
[Chemical formula 44]



[0097]A triazole series high molecular compound as shown by [the-izing 43] and the [-izing 44] etc. can be mentioned.
[0098]The electron transport layer 60 is a layer for conveying the electron poured in from the catholyte 70, and contains an electron transporting agent. The composition which comprises an electron-transport-property polymer and contains an electron-transport-property low molecule further is possible for an electron transporting agent.
[0099]PBD shown in [the-izing 31] as an example of an electron-transport-property low molecule here, Alq3 which are shown in [the-izing 33], TAZ shown in [the-izing 34], DPVBi shown in [the-izing 35], BND shown in [the-izing 36], DTVBi shown in [the-izing 37], BBD shown in [the-izing 38], etc. can be mentioned.
[0100]A triazole series high molecular compound as shown as an example of an electron-transport-property polymer by an oxadiazole system high molecular compound, the [-izing 43], and the [-izing 44] as shown by the [-izing 39] thru/or the [-izing 42], [0101]
[Chemical formula 45]


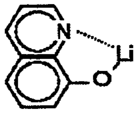
[0102](R shows hydrogen, an aliphatic hydrocarbon group, an aromatic hydrocarbon group, an ether group, or a heterocycle group among a general formula [the-izing 45].)
The Polyful Oren compound etc. which have a general formula [the-izing 45] in a repeating unit are mentioned.
[0103]The element structure shown in drawing 2 thru/or drawing 5 is possible as what added change to the basic structure of the organic electroluminescence element shown in drawing 1 because of the further improvement in luminous efficiency, or the simplification of structure.
[0104]The element structure of the organic electroluminescence element shown by drawing 2 shows a 1st embodiment of the organic electroluminescence element of this invention. Although the electron block layer 30 and the hole block layer 50 of drawing 1 are omitted, in drawing 2, the electronic block effect can be given to the electron hole transporting bed 20, an electron hole block effect can be given to the electron transport layer 60, respectively, and luminous efficiency can be maintained.
[0105]In the element structure shown by drawing 1, the element structure of the organic electroluminescence element shown by drawing 3 omits the electron block layer 30 and the hole block layer 50, and adds the hole injection layer 21 which comprises a hole injectional substance between the positive electrode layer 10 and the electron hole transporting bed 20.
[0106]Metal phthalocyanines, such as kappa phthalocyanine shown in [the-izing 8] as a hole injectional substance, for example, [0107]
[Chemical formula 46]


[0108]Poly(3, 4) ethylene dioxythiophene / polystyrene SARUFONETO (henceforth PEDT/PSS) shown by [the-izing 46] are mentioned.
[0109]The element structure of the organic electroluminescence element shown by drawing 4 omits the electron block layer 30 from the element structure shown by drawing 1.
[0110]From the element structure shown by drawing 1, the element structure of the organic electroluminescence element shown by drawing 5 omits the electron block layer 30 and the hole

block layer 50, and adds the electronic injection layer 61 constituted by an electron injectional substance between the electron transport layer 60 and the catholyte 70.

[0111]As an electron injectional substance, they are lithium fluoride and lithium oxide, for example, [0112]

[Chemical formula 47]



[0113]8-hydroxyquinolinate lithium (henceforth [Liq]) etc. which are shown by [the-izing 47] are mentioned.

[0114]Next, the manufacturing method of an organic electroluminescence element is explained for drawing 2 as a 1st embodiment of this invention.

[0115]First, the positive electrode layer 10 is formed by vacuum deposition or a sputtering method on the transparent insulating support body used as a substrate (not shown), for example, a glass substrate.

[0116]Next, the 1st solution that dissolved or distributed the hole-transport polymer or the hole-transport low molecule to the solvent is created. Here, it is also possible to dissolve or distribute a binder polymer further in the 1st solution. And the electron hole transporting bed 20 is formed on the positive electrode layer 10 with the wet process using the 1st solution.

[0117]The 2nd solution that dissolved or distributed the dopant 41 and the host agent 42 of the luminous layer 40 to the solvent is created. Here, it is also possible to dissolve or distribute a binder polymer further in the 2nd solution. And the luminous layer 40 is formed on the above-mentioned electron hole transporting bed 20 with the wet process using the 2nd solution.

[0118]The 3rd solution that dissolved or distributed the electron-transport-property polymer or the electron-transport-property low molecule to the solvent is created. Here, it is also possible to dissolve or distribute a binder polymer further in the 3rd solution. With the wet process using the 3rd solution, the electron transport layer 60 is formed on the luminous layer 40.

[0119]The solubility parameter of the solvent used for the 2nd solution has a value which shows the outside of the meltable range to the substances (hole-transport substance etc. which comprises a hole-transport polymer or a hole-transport low molecule) contained in the electron hole transporting bed 20 at the forming temperature of the luminous layer 40. In formation of the luminous layer 40 by wet process using such a solvent, the organic matter contained in the lower layer electron hole transporting bed 20 is not dissolved.

[0120]It becomes easy to choose here the solvent used for the 2nd solution as the solubility parameter range of the hole-transport substance contained in the electron hole transporting bed 20 is below $10.0(cal/cm^3)^{1/2}$ in a room temperature in more than $8.9(cal/cm^3)^{1/2}$.

[0121]On the other hand, the polymer which has [the-izing 1] as a repeating unit can adjust the solubility parameter range by choosing R under [-izing 1], and a molecular weight. Thus, when a solubility parameter in a room temperature of hole-transport substance slack and a polymer which has [the-izing 1] as a repeating unit is made for more than $8.9(cal/cm^3)^{1/2}$ to be in a range below $10.0(cal/cm^3)^{1/2}$, As a solvent used for the 2nd solution, the range of this solubility parameter outside, i.e., [more than $7.0(cal/cm^3)^{1/2}$], less than $8.9(cal/cm^3)^{1/2}$. Or if a solvent which is in below $13.0(cal/cm^3)^{1/2}$ more greatly than $10.0(cal/cm^3)^{1/2}$ is used, The luminous layer 40 can be formed without dissolving a poly carbazole compound which has the above [the-izing 1] included in the electron hole transporting bed 20 in a repeating unit. In the above-mentioned numeric value range, a solvent which has a solubility parameter of below $7.0(cal/cm^3)^{1/2}$, or $13.0(cal/cm^3)^{1 / \text{more than } 2}$ hardly exists.

[0122]as the example of the solvent used for the 2nd solution of the above -- n-pentane (the solubility parameter in a room temperature.) the following -- the same : -- $7.05(cal/cm^3)^{1/2}$, and hexane ($7.30(cal/cm^3)^{1/2}$). Heptane ($7.45(cal/cm^3)^{1/2}$), n-octane (7.54 $^{(cal/cm^3)\ 1/2}$), n-nonane

(7.64$(cal/cm^3)^{1/2}$), n-Deccan (7.74 $(cal/cm^3)^{1/2}$), 1-decene (7.85$(cal/cm^3)^{1/2}$), a methylcyclohexane (8.13$(cal/cm^3)^{1/2}$), Cyclohexane (8.20$(cal/cm^3)^{1/2}$), 1-chloropropane (8.30 $(cal/cm^3)^{1/2}$), Tetrachloromethane (8.60$(cal/cm^3)^{1/2}$), Ethylbenzene (8.70$(cal/cm^3)^{1/2}$), m-xylene (8.80$(cal/cm^3)^{1/2}$), alpha bromonaphthalene (10.60$(cal/cm^3)^{1/2}$), nitroethane (11.10$(cal/cm^3)^{1/2}$), Acetonitrile (11.80$(cal/cm^3)^{1/2}$), nitromethane (12.70$(cal/cm^3)^{1/2}$), etc. are mentioned. Of course, the solvent which can use the 2nd solution, In more than 7.0$(cal/cm^3)^{1/2}$, the solubility parameter in a room temperature Less than 8.9$(cal/cm^3)^{1/2}$. Or it is larger than 10.0$(cal/cm^3)^{1/2}$, and what is necessary is just a solvent belonging to the range below 13.0$(cal/cm^3)^{1/2}$, and it is not limited to the solvent illustrated above.

[0123]The solubility parameter of the solvent used for the 3rd solution has a value which shows the outside of the meltable range to the substances (the dopant 41, the host agent 42, a binder polymer, etc.) contained in the luminous layer 40 at the forming temperature of the electron transport layer 60. The organic matter using such a solvent contained in the lower layer luminous layer 40 in formation of the electron transport layer 60 by wet process is not dissolved.

[0124]At this time, when the solvent used for the above-mentioned 1st thru/or the 3rd solution evaporates by natural seasoning, the electron hole transporting bed 20, the luminous layer 40, and the electron transport layer 60 are formed. In this case, it is not necessary to process heating, the polymerization by the exposure of ultraviolet rays, hardening, etc., therefore a manufacturing process is easy, and productive efficiency can be raised.

[0125]The usual coating methods, such as casting method, the blade coat method, a dip coating method, a spin coat method, a spray coating method, a roll coating method, and an ink jet coating method, are included in the wet process used by this invention, for example.

[0126]Finally, vacuum deposition etc. are used, the catholyte 70 is formed on the electron transport layer 60, and the organic electroluminescence element of this invention is obtained.

[0127]Solubility parameter SP is defined by $SP=[(deltaH-RT)/V]^{1/2}$ at the absolute temperature T of the liquid of molar-heat-of-vaporization deltaH and molar volume V. However, SP is a solubility parameter (unit: $(cal/cm^3)^{1/2}$) among the above-mentioned formula, deltaH is the molar heat of vaporization (unit: cal/mol), R is a gas constant (unit: cal/(mol-K)), T is the absolute temperature (unit: K), and V is molar volume (unit: cm^3/mol).

[0128]Drawing 3 is a 2nd embodiment of the organic electroluminescence element of this invention, Before formation of the electron hole transporting bed 20 among the manufacturing process of the element structure shown by above-mentioned drawing 2, Pass the manufacturing process which forms the electron hole transporting bed 20, the luminous layer 40, the electron transport layer 60, and the catholyte 70 one by one like above-mentioned drawing 2 on this hole injection layer 21 after forming hole injectional substances, such as PEDT, with wet process and forming the hole injection layer 21 on the positive electrode layer 10.

[0129]Drawing 4 is a 3rd embodiment of the organic electroluminescence element of this invention, Before formation of the electron transport layer 60 among the manufacturing process of the element structure shown by above-mentioned drawing 2, Pass the manufacturing process which forms the electron transport layer 60 and the catholyte 70 one by one like above-mentioned drawing 2 on this hole block layer 50 after forming electron hole block nature substances, such as BCP, with vacuum deposition and forming the hole block layer 50 on the luminous layer 40.

[0130]Drawing 5 is a 4th embodiment of the organic electroluminescence element of this invention, Before formation of the catholyte 70 among the manufacturing process of the element structure shown by above-mentioned drawing 2, Pass the manufacturing process which forms the catholyte 70 like above-mentioned drawing 2 on this electronic injection layer 61 after forming electron injectional substances, such as lithium fluoride, with vacuum deposition and forming the electronic injection layer 61 on the electron transport layer 60.

[0131]

[Working example]It was shown by [Embodiment 1] and the [-izing 9], 6 mg of polymers of the

polystyrene equivalent weight normal (henceforth a molecular weight) 60,000 measured with gel par EISHON chromatography were dissolved by 1 and 2 1-ml dichloroethane, and the solution 1 was created. An electron hole transporting bed of 50-nm thickness was obtained by carrying out the spin coat of the solution 1 in number of rotations of 1000 rpm, and 1 second on an ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.

[0132]Ir(ppy) $_3$ shown by OXD-1 shown by [the-izing 13] as a luminous layer with a vacuum evaporator on an electron hole transporting bed at degree-of-vacuum 10^{-3}Pa, and the [-izing 15] so that Ir(ppy) $_3$ may be 6.5weight %, Carry out vapor codeposition in sec in 1nm /as an evaporation rate of OXD-1, and membranes are formed to 20-nm thickness, Alq3 was formed to 50-nm thickness with an evaporation rate of 1nm/sec as an electron transport layer, vapor codeposition of aluminum and the lithium was carried out to the last with an evaporation rate of 1nm/sec so that lithium might be 1%, an anode was formed in it, and an element shown in drawing 2 was created.

[0133]At this time, green luminescence of 500 cd/m^2 (it is [luminosity and the following] the same) was obtained by 4V (it is [driver voltage and the following] the same) and 1 mA/cm^2 (it is [current density and the following] the same).

[0134]The element shown in drawing 2 like [Embodiment 1] was created except having used PVK of the molecular weight 1,100,000 shown in [the-izing 4] instead of [the comparative example 1] and the [-izing 9]. At this time, green luminescence of 500 cd/m^2 was obtained by 7V and 1 mA/cm^2.

[0135]The element shown in drawing 2 like [Embodiment 1] was created except having carried out film formation by vacuum evaporation using NPD shown in [the-izing 3] instead of [the comparative example 2] and the [-izing 9]. The evaporation rate of 1nm/sec performed the vacuum evaporation conditions at this time by degree-of-vacuum 10^{-3}Pa. At this time, green luminescence of 400 cd/m^2 was obtained by 5V and 1 mA/cm^2.

[0136][Embodiments 2-9] And the element shown in drawing 2 like [Embodiment 1] and the [comparative example 1], and the [comparative example 2] was created except having used the polymer which has the [-izing 1] using the substituent shown in following [table 1] as a repeating unit for R under [-izing 1] instead of [the comparative examples 3 and 4] and the [-izing 9]. When all the molecular weights at this time were set to 60,000, they obtained luminescence of the luminous efficiency shown in following [table 1].

[0137]

[Table 1]

実施例	R	1mA/c㎡での性能	
		電圧 (V)	輝度(cd/㎡)
2	CH_3	4.0	500
3	C_2H_5	4.0	500
4	$C(CH_3)_3$	4.0	500
5	$C_{10}H_{21}$	4.2	500
6	$OC(CH_3)_3$	4.0	450
7	$OC_{10}H_{21}$	4.2	450
8	$C_6H_4CH_3$	4.0	500
9	$C_{12}H_8N$	4.1	520
比較例3	$C_{11}H_{23}$	4.4	400
比較例4	$OC_{11}H_{23}$	4.4	400

[0138]If the number of carbon atoms in the substituent which will be replaced as R if [Embodiment 6] is compared with [the comparative example 4] becomes large, voltage will rise and luminosity will fall [Embodiment 5] and the [comparative example 3]. From this, the carbon number of the hydrocarbon group used for R is understood that ten or less are desirable.

[0139][Embodiment 10] The element shown in drawing 3 like [Embodiment 1] was created except having formed poly(3, 4) ethylene dioxythiophene (PEDT) with the spin coat in the number of rotations of 4000 rpm, and 10 seconds as a hole injection layer between the ITO board and the

electron hole transporting bed at 50-nm thickness. At this time, green luminescence of 480 cd/m^2 was obtained by 3.8V and 1 mA/cm^2.
[0140][Embodiment 11] The element shown in drawing 3 like [Embodiment 1] was created except having formed the kappa phthalocyanine shown by [the-izing 8] with vacuum deposition as a hole injection layer between the ITO board and the electron hole transporting bed at 2-nm thickness with degree-of-vacuum 10^{-3}Pa and the evaporation rate of 0.1nm/sec. At this time, green luminescence of 480 cd/m^2 was obtained by 3.8V and 1 mA/cm^2.
[0141]Except having used the compound which is changed to Ir(ppy) $_3$ of luminous layer dopant in [Embodiments 12-23] and [Embodiment 1], and is shown in following [table 2], when the element shown in drawing 2 like [Embodiment 1] was created, luminescence of the luminous efficiency shown in [Table 2] was obtained.
[0142]
[Table 2]

実施例	化合物	1mA/c㎡での性能		発光ピーク波長 (nm)
		電圧 (V)	輝度(cd/㎡)	
12	[化16]	4.1	450	545
13	[化17]	4.1	290	563
14	[化18]	4.2	550	525
15	[化19]	3.9	360	555
16	[化20]	3.9	50	608
17	[化21]	4.0	510	516
18	[化23]	4.1	450	545
19	[化24]	4.1	280	563
20	[化25]	3.9	540	525
21	[化26]	4.1	360	555
22	[化27]	4.0	40	608
23	[化28]	3.8	15	647

[0143][Embodiment 24] The element shown in drawing 2 like [Embodiment 1] was created except having used CBP which is changed to OXD-1 of a luminous layer host agent, and is shown in [the-izing 6]. At this time, green luminescence of 400 cd/m^2 was obtained by 4V and 1 mA/cm^2.

[0144][Embodiment 25] The element shown in drawing 2 like [Embodiment 1] was created except having changed to Alq3 and having used OXD-1 as an electron transport layer. At this time, green luminescence of 500 cd/m^2 was obtained by 4.5V and 1 mA/cm^2.
[0145][Embodiment 26] The element shown in drawing 4 like [Embodiment 24] was created except having formed BCP shown in [the-izing 32] with vacuum deposition by 6-nm thickness as a hole block layer between the luminous layer and the electron transport layer. The vacuum evaporation conditions of this hole block layer were 0.1nm/sec in degree-of-vacuum 10^{-3}Pa and evaporation rate. At this time, green luminescence of 480 cd/m^2 was obtained by 4V and 1 mA/cm^2.
[0146][Embodiment 27] Lithium fluoride was formed with vacuum deposition by 5-nm thickness as an electronic injection layer between the electron transport layer and the anode, and the element shown in drawing 5 like [Embodiment 1] was created except having changed the anode to aluminum. The vacuum evaporation conditions of this electronic injection layer were 0.1nm/sec in degree-of-vacuum 10^{-3}Pa and evaporation rate.
[0147]At this time, green luminescence of 500 cd/m^2 was obtained by 4V and 1 mA/cm^2.
[0148]It was shown by [Embodiment 28] and the [-izing 9], 6 mg of polymers of the molecular weight 60,000 were dissolved by 1 and 2 1-ml dichloroethane, and the solution 1 was created.
[0149]It is 0.17 mg as 2.5 mg and Ir(ppy) $_3$ as OXD-1. 2.5 mg of polyvinyl biphenyl of the molecular weight 115,000 was dissolved in 1 ml of m-xylene as a binder polymer, and the solution 2 was created.
[0150]The electron hole transporting bed of 50-nm thickness was obtained by carrying out the spin coat of the solution 1 in the number of rotations of 1000 rpm, and 1 second on the ITO

board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0151]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 in the number of rotations of 1000 rpm, and 1 second on an electron hole transporting bed.
[0152]Alq3 as an electron transport layer with a vacuum evaporator Degree-of-vacuum 10^{-3}Pa, Membranes were formed to 50-nm thickness with the evaporation rate of 1nm/sec, and the element which carries out vapor codeposition of aluminum and the lithium to the last with the evaporation rate of 1nm/sec so that lithium may be 1%, forms an anode in it, and is shown in drawing 2 was created.
[0153]At this time, green luminescence of 480 cd/m^2 was obtained by 6V and 1 mA/cm^2.
[0154][Embodiment 29] The element shown in drawing 2 like [Embodiment 28] was created except having changed OXD-1 of the solution 2 into CBP. At this time, green luminescence of 400 cd/m^2 was obtained by 6V and 1 mA/cm^2.
[0155][Embodiments 30-41] Except having used the compound which is changed to Ir(ppy) $_3$ of the solution 2, and is shown in following [table 3], when the element shown in drawing 2 like [Embodiment 28] was created, luminescence of the luminous efficiency shown in [Table 3] was obtained.
[0156]
[Table 3]

実施例	化合物	1mA/c㎡での性能		発光ピーク波長 (nm)
		電圧 (V)	輝度 (cd/㎡)	
30	[化16]	6.1	450	545
31	[化17]	6.1	290	563
32	[化18]	6.2	550	525
33	[化19]	5.9	360	555
34	[化20]	5.9	50	608
35	[化21]	6.0	510	516
36	[化23]	6.1	450	545
37	[化24]	6.1	280	563
38	[化25]	5.9	540	525
39	[化26]	6.1	360	555
40	[化27]	6.0	40	608
41	[化28]	5.8	15	647

[0157]It was shown by [Embodiment 42] and the [-izing 40], and the element shown in drawing 2 like [Embodiment 28] was created except having dissolved 0.17 mg in 1 ml of m-xylene as 5 mg and Ir(ppy) $_3$ as a polymer of the molecular weight 20,000, and having created the solution 2. At this time, green luminescence of 480 cd/m^2 was obtained by 5V and 1 mA/cm^2.
[0158]It was shown by [Embodiment 43] and the [-izing 42], and the element shown in drawing 2 like [Embodiment 28] was created except having dissolved 0.17 mg in 1 ml of m-xylene as 5 mg of polymers of the molecular weight 20,000, and Ir(ppy) $_3$, and having created the solution 2. At this time, green luminescence of 480 cd/m^2 was obtained by 5V and 1 mA/cm^2.
[0159]The element shown in drawing 2 like [Embodiment 28] was created except having used the polymer using the substituent shown in following [table 4] as R under [-izing 1] instead of [Embodiments 44-48] and the [-izing 9]. At this time, all the molecular weights of the above-mentioned polymer were set to 60,000. At this time, luminescence of the luminous efficiency shown in [Table 4] was obtained.
[0160]
[Table 4]

実施例	R	1mA/c㎡での性能	
		電圧 (V)	輝度(cd/㎡)
44	$C(CH_3)_3$	4.0	500
45	$C_{10}H_{21}$	4.2	500
46	$OC_{10}H_{21}$	4.2	450
47	$C_6H_4CH_3$	4.0	500
48	$C_{12}H_8N$	4.1	520

[0161]It was shown by [Embodiment 49] and the [-izing 9], 6 mg was dissolved in 1 and 2 1-ml dichloroethane as a polymer of the molecular weight 60,000, and the solution 1 was created.
[0162]2.5 mg of polyvinyl biphenyl of the molecular weight 115,000 was dissolved in 1 ml of m-xylene as 0.17 mg and a binder polymer as 2.5 mg and Ir(ppy) $_3$ as OXD-1, and the solution 2 was created.
[0163]2.5 ml of polystyrene of the molecular weight 10,000 was dissolved in 1 ml of cyclohexane as 2.5 mg and a binder polymer as PBD, and the solution 3 was created. The electron hole transporting bed of 50-nm thickness was obtained by carrying out the spin coat of the solution 1 in the number of rotations of 1000 rpm, and 1 second on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0164]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 in the number of rotations of 1000 rpm, and 1 second on an electron hole transporting bed.
[0165]The electron transport layer of 50-nm thickness was obtained by carrying out the spin coat of the solution 3 in the number of rotations of 1000 rpm, and 1 second on a luminous layer.
[0166]With the vacuum evaporator, with degree-of-vacuum 10^{-3}Pa and the evaporation rate of 1nm/sec, vapor codeposition of aluminum and the lithium was carried out, the anode was formed in the last so that lithium might be 1%, and the element shown in drawing 2 was created.
[0167]At this time, green luminescence of 450 cd/m^2 was obtained by 7V and 1 mA/cm^2.
[0168]It was shown by [Embodiment 50] and the [-izing 9], 6 mg of polymers of the molecular weight 60,000 were dissolved by 1 and 2 1-ml dichloroethane, and the solution 1 was created. The electron hole transporting bed of 50-nm thickness was obtained by carrying out the spin coat of the solution 1 for 1 second at the number of rotations of 1000 rpm on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0169]On an electron hole transporting bed, the coumarin 6 shown in DPVBi shown in [the-izing 35] by degree-of-vacuum 10^{-3}Pa with a vacuum evaporator, and the [-izing 29], Carry out vapor codeposition with the evaporation rate of 1nm/sec of DPVBi, and the luminous layer of 20-nm thickness is formed so that the coumarin 6 may be 1weight %, The electron transport layer of 50-nm thickness was formed by Alq3, vapor codeposition of aluminum and the lithium was carried out to the last with the evaporation rate of 1nm/sec so that lithium might be 1%, the anode was formed in it, and the element shown in drawing 2 was created.
[0170]At this time, green luminescence of 130 cd/m^2 was obtained by 5V and 1 mA/cm^2.
[0171][Embodiment 51] The element shown in drawing 2 like [Embodiment 50] was created except having used DCM2 shown in [the-izing 30] instead of the coumarin 6. At this time, luminescence of the red of 50 cd/m^2 was obtained by 5V and 10 mA/cm^2.
[0172]The element shown in drawing 2 like [Embodiment 1] was created except having used the polymer which has the molecular weight 60,000 in [the-izing 10] instead of [Embodiment 52] and the [-izing 9]. At this time, green luminescence of 480 cd/m^2 was obtained by 3.8V and 1 mA/cm^2.
[0173][Embodiment 53] It measured that the table of the dissolution range when R under [-izing 1] is made into the alkyl group (- C_nH_{2n+1}) of a straight chain should be carried out by a solubility parameter. The measuring method created the test piece which laminated on the substrate the thin film which has predetermined thickness by the method shown as [the

experiment 1] below, and performed it by measuring the dissolution range over the solvent which has a predetermined solubility parameter.
[0174][Experiment 1] 6 mg of polymers used as the material of thin film layers, such as the electron hole transporting bed which constitutes an organic electroluminescence element, an electron block layer, a luminous layer, a hole block layer, an electron transport layer, and an electronic injection layer, are dissolved in 1 ml of trichloromethane, and a solution is created. On the ITO board (Asahi Glass [Co., Ltd.] make: 20ohm/**) of marketing which performed oxygen plasma treatment, the spin coat of this solution is carried out in the number of rotations of 1500 rpm, and 1 second, a 50-nm substrate with a thin film is created, and it is considered as a test piece.
[0175]
[Table 5]

溶媒名	溶解度パラメータ
n-ペンタン	7.05
ヘキサン	7.30
ヘプタン	7.45
n-オクタン	7.54
n-ノナン	7.64
n-デカン	7.74
1-デセン	7.85
メチルシクロヘキサン	8.13
シクロヘキサン	8.20
1-クロロプロパン	8.30
テトラクロロメタン	8.60
エチルベンゼン	8.70
m-キシレン	8.80
トルエン	8.90
トリクロロメタン	9.10
ベンゼン	9.20
トリクロロエチレン	9.30
クロロベンゼン	9.60
1.2-ジクロロエタン	9.70
ブロモベンゼン	9.90
o-ジクロロベンゼン	10.00
αブロモナフタリン	10.60
ニトロエタン	11.10
アセトニトリル	11.80
ニトロメタン	12.70

[0176]As the solvent which has a solubility parameter shown in [Table 5] is prepared for the ascending order of these solubility parameter value and is shown in drawing 6 (a) and drawing 6 (b), As the beaker 2 filled with those solvents 1 is made to immerse the test piece 3 for 10 seconds, respectively and it is shown in drawing 6 (c) after that, it is checked visually whether the test piece 3 was taken out and the thin film has dissolved.
[0177]The minimum and the maximum are defined as the dissolution range of a test piece among the solubility parameters of the solvent which a thin film dissolves.
[0178]The polymer used at this time was made into the molecular weight 100,000. The result of the dissolution range is shown in following [table 6].
[0179]
[Table 6]

n	溶解範囲	
	上限	下限
0	9.1	8.9
1	9.2	9.1
2	9.3	9.1
3	9.3	9.1
4	9.6	9.1
5	9.6	9.1
6	9.6	9.1
7	9.6	9.1
8	9.9	9.1
9	9.9	9.1
10	10.0	9.1
11	10.6	9.1
12	10.6	9.1

[0180]It turns out that the dissolution range can be adjusted with [Table 6] by the length of the alkyl group shown as R.

[0181]If the dissolution range is adjusted to 8.9 - 10.0 $^{(cal/cm^3)\ 1/2}$ at this time, it will become easy to choose the solvent at the time of the upper membrane formation.
[0182]Here, R of [the-izing 1] was made into the alkyl ($-C_nH_{2n+1}$) of a straight chain, 6 mg was dissolved by 1 ml of trichloromethane as a polymer made into the molecular weight 100,000, and the solution 1 was created.
[0183]2.5 mg of polyvinyl biphenyl of the molecular weight 100,000 was dissolved in 1 ml of m-xylene as 0.17 mg and a binder polymer as 2.5 mg and Ir(ppy) $_3$ as OXD-1, and the solution 2 was created.
[0184]The electron hole transporting bed of 50-nm thickness was formed by carrying out the spin coat of the solution 1 for 1 second at the number of rotations of 1500 rpm on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0185]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 for 1 second at the number of rotations of 1000 rpm on an electron hole transporting bed.
[0186]Alq3 was formed as an electron transport layer with the vacuum evaporator at 50-nm thickness with degree-of-vacuum 10^{-3}Pa and the evaporation rate of 1nm/sec, vapor codeposition of aluminum and the lithium was carried out to the last with the evaporation rate of 1nm/sec so that lithium might be 1%, and the anode was formed in it. Thus, when the element shown in drawing 2 was created, luminescence of the luminous efficiency shown in following [table 7] was obtained.
[0187]
[Table 7]

n	1mA/c㎡での性能	
	電圧 (V)	輝度 (cd/㎡)
0	3.8	480
1	3.8	480
2	3.8	480
3	3.9	490
4	3.9	500
5	3.9	500
6	4.0	500
7	4.0	510
8	4.1	510
9	4.2	510
10	4.3	520
11	4.4	520
12	4.5	510

[0188]Thereby, when the substituent shown as R during [the-izing 1] is an alkyl group, the dissolution range of the polymer which has [the-izing 1] in a repeating unit can be adjusted, and

it becomes easy to choose the solvent used for the upper membrane formation by choosing this alkyl group.
[0189][Embodiment 54] The element shown in drawing 2 like [Embodiment 53] was created except having used trichloromethane for the solvent of the solution 2.
[0190]Since a lower layer dissolved with all the elements at the time of the upper membrane formation at this time, the element was not able to be created.
[0191][Embodiment 55] Except having used alpha bromonaphthalene for the solvent of the solution 2, when the element shown in drawing 2 like [Embodiment 53] was created, luminescence of the luminous efficiency shown in following [table 8] was obtained.
[0192]
[Table 8]

n	1mA/c㎡での性能	
	電圧 (V)	輝度(cd/㎡)
0	3.8	470
1	3.8	480
2	3.8	480
3	3.9	490
4	3.9	500
5	3.9	500
6	4.0	500
7	4.0	510
8	4.1	510
9	4.2	510
10	4.2	510
11	素子作成不能	
12		

[0193]In n= 11−12, since a lower layer dissolved at the time of the upper membrane formation, the element was not able to be created.
[0194]When R of [Embodiment 56] and the [−izing 1] was made into $-C_8H_{17}$ of a straight chain, it measured that the table of the dissolution range of various molecular weights should be carried out by a solubility parameter. When the measuring method was performed like the [experiment 1] in [Embodiment 53], the result shown in following [table 9] was obtained.
[0195]
[Table 9]

分子量	溶解範囲	
	上限	下限
10,000	11.10	8.70
60,000	10.60	8.90
100,000	9.90	9.10
500,000	9.70	9.10
1,000,000	9.70	9.30

[0196]It turns out that the dissolution range can be adjusted with a molecular weight from [Table 9].
[0197]If the dissolution range is adjusted to 8.9 − 10.0 $^{(cal/cm^3)\ 1/2}$ at this time, it will become easy to choose the solvent at the time of the upper membrane formation.
[0198]Here, 6 mg was dissolved by 1 and 2 1-ml dichloroethane as a polymer in each molecular weight when R under [−izing 1] is made into $-C_8H_{17}$ of a straight chain, and the solution 1 was created.
[0199]2.5 mg of polyvinyl biphenyl of the molecular weight 115,000 was dissolved in 1 ml of ethylbenzene as 0.17 mg and a binder polymer as 2.5 mg and $Ir(ppy)_3$ as OXD−1, and the solution 2 was created.
[0200]The electron hole transporting bed of 50−nm thickness was formed by carrying out the spin coat of the solution 1 for 1 second at the number of rotations of 1000 rpm on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.

[0201]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 for 1 second at the number of rotations of 1000 rpm on an electron hole transporting bed.
[0202]Alq3 was formed as an electron transport layer of 50-nm thickness with the vacuum evaporator with degree-of-vacuum 10^{-3}Pa and the evaporation rate of 1nm/sec, vapor codeposition of aluminum and the lithium was carried out to the last with the evaporation rate of 1nm/sec so that lithium might be 1%, and the anode was formed in it. Thus, when the element shown in drawing 2 was created, luminescence of the luminous efficiency shown in following [table 10] was obtained.
[0203]
[Table 10]

分子量	1mA/c㎡での性能	
	電圧 (V)	輝度(cd/㎡)
10,000	素子作成不能	
60,000	4.2	500
100,000	4.1	510
500,000	4.1	510
1,000,000	4.0	510

[0204]In the molecular weight 10,000, since a lower layer dissolved at the time of the upper membrane formation, the element was not able to be created.
[0205][Embodiment 53] Or when the substituent shown as R during [the-izing 1] is an alkyl group, this dissolution range can be adjusted and it becomes easy to choose the solvent used for the upper membrane formation by choosing the molecular weight of the polymer which has [the-izing 1] in a repeating unit from the result to [Embodiment 56].
[0206][Embodiment 57] R under [-izing 1] was made into $-C_8H_{17}$ of a straight chain, 6 mg was dissolved by 1 and 2 1-ml dichloroethane as a polymer which set the molecular weight to 100,000, and the solution 1 was created.
[0207]The dissolution ranges of this polymer were 9.1 - 9.9 $^{(cal/cm^3)\ 1/2}$ in the room temperature.

[0208]2.5 mg of polystyrene (molecular weight 10,000) was dissolved in 1 ml of solvents shown in following [table 11] as 0.17 mg and a binder polymer, respectively as an iridium complex compound shown by 2.5 mg and the [-izing 21] as PBD, and the solution 2 was created.
[0209]The electron hole transporting bed of 50-nm thickness was formed by carrying out the spin coat of the solution 1 for 1 second at the number of rotations of 1000 rpm on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0210]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 for 1 second at the number of rotations of 1000 rpm on an electron hole transporting bed.
[0211]Alq3 was formed as an electron transport layer with the evaporation rate of 1nm/sec by degree-of-vacuum 10^{-3}Pa with the vacuum evaporator at 50-nm thickness, vapor codeposition of aluminum and the lithium was carried out to the last with the evaporation rate of 1nm/sec so that lithium might be 1%, and the anode was formed in it. Thus, when the element shown in drawing 2 was created, luminescence of the luminous efficiency shown in following [table 11] was obtained.
[0212]
[Table 11]

溶媒名	溶解度パラメータ	1mA/c㎡での性能	
		電圧 (V)	輝度(cd/㎡)
1-デセン	7.85	4.5	480
メチルシクロヘキサン	8.13	4.1	510
シクロヘキサン	8.20	4.1	510
1-クロロプロパン	8.30	4.1	510
テトラクロロメタン	8.60	4.1	510
エチルベンゼン	8.70	4.1	510
m-キシレン	8.80	4.1	510
トルエン	8.90	4.1	510
トリクロロメタン	9.10	素子作成不能	
ブロモベンゼン	9.90		
o-ジクロロベンゼン	10.00	4.1	510
αブロモナフタリン	10.60	4.2	490
ニトロエタン	11.10	5.0	480
アセトニトリル	11.80	5.0	480

[0213]If the solvent of the lower layer insoluble range is used even if it changes a solvent, in 1 mA/cm^2, dispersion in luminosity will be less than 10%.
[0214][Embodiment 58] When the dissolution range of each polymer of the molecular weight 100,000 which has ** [the-izing 1] in a repeating unit was measured by the measuring method shown in [the experiment 1] using the substituent shown in following [table 12] as R under [-izing 1], the result shown in following [table 12] was obtained.
[0215]From the dissolution range shown in following [table 12], also when the substituent shown as R during [the-izing 1] is an alkoxyl group or an aryl group, the dissolution range of the polymer which chooses the substituent and has [the-izing 1] in a repeating unit can be adjusted. Therefore, the solvent used for a luminous layer can be made easy to choose the substituent shown as R during [the-izing 1], and to choose so that it may have a solubility parameter which becomes insoluble to the solvent used at the time of membrane formation of the upper slack luminous layer.
[0216]Here, 6 mg was dissolved by 1 ml of trichloromethane (it is nitroethane only when R is CH_3NH_2) as a polymer which has ** [the-izing 1] in a repeating unit using the substituent shown in following [table 12] as R under [-izing 1], and the solution 1 was created.
[0217]2.5 mg of polyvinyl biphenyl of the molecular weight 100,000 was dissolved in 1 ml of o-dichlorobenzene as 0.17 mg and a binder polymer as 2.5 mg and $Ir(ppy)_3$ as OXD-1, and the solution 2 was created.
[0218]The electron hole transporting bed of 50-nm thickness was formed by carrying out the spin coat of the solution 1 for 1 second at the number of rotations of 1500 rpm on the ITO board (below the marketing ITO, and Asahi Glass Co., Ltd. make:20ohms /, and **) which performed oxygen plasma treatment.
[0219]The luminous layer of 20-nm thickness was obtained by carrying out the spin coat of the solution 2 for 1 second at the number of rotations of 1000 rpm on an electron hole transporting bed.
[0220]With the vacuum evaporator, Alq3 was vapor-deposited with degree-of-vacuum 10^{-3}Pa and the evaporation rate of 1nm/sec, the electron transport layer of 50-nm thickness was formed, vapor codeposition of aluminum and the lithium was carried out to the last with the evaporation rate of 1nm/sec so that lithium might be 1%, and the anode was formed in it.
[0221]Thus, when the element shown in drawing 2 was created, luminescence of the luminous efficiency shown in following [table 12] was obtained.
[0222]
[Table 12]

R	溶解範囲		1mA／cm²での性能	
	上限	下限	電圧 (V)	輝度(cd/m²)
OC_2H_5	9.6	9.2	4.4	430
OC_3H_7	9.9	9.1	4.5	450
OC_4H_9	10.0	9.1	素子作成不能	
$C(CH_3)_3$	9.7	9.2	4.5	400
$OC(CH_3)_3$	9.7	9.1	4.6	420
C_6H_5	9.7	9.1	4.5	410
$C_6H_4CH_3$	10.0	9.1	素子作成不能	
CH_3NH_2	11.8	10.6	4.6	400
COOH	9.9	8.8	4.7	390

[0223]By [Table 12], also when the substituents shown as R during [the-izing 1] are an alkoxyl group and an aryl group,. The electron hole transporting bed and luminous layer which are constituted using the polymer which it has in a repeating unit can laminate [the-izing 1] with wet process like the case of an alkyl group, and luminescence of the organic electroluminescence element of such a structure is obtained.
[0224]Lamination with such an electron hole transporting bed and a luminous layer uses an alkoxyl group and an aryl group for the substituent shown as R during [the-izing 1] like the case of an alkyl group, and chooses the molecular weight of the polymer which has ** [the-izing 1] in a repeating unit, It can form also by adjusting the dissolution range of the polymer.
[0225]
[Effect of the Invention]Since the hole-transport polymer used for this invention is a conductive polymer which has a carbazolyl group in a main chain so that clearly from the above explanation, it has high hole mobility and high ionization potential is maintainable. For this reason, an electron hole can move to a luminous layer certainly from an electron hole transporting bed. Therefore, since high-intensity luminescence is comparatively obtained by the drive of the low voltage, the organic electroluminescence element of this invention can improve luminous efficiency.
[0226]Since the hole-transport polymer used for this invention chooses the substituent in molecular structure, and the molecular weight of a polymer and can adjust the dissolution range, it becomes easy to choose the solvent used for membrane formation of an adjacent layer slack luminous layer, and creation of element structure is easy for it.

[Translation done.]

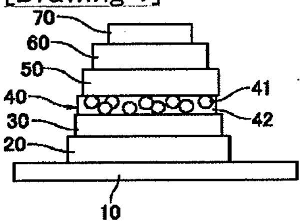
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]Element structure of an organic electroluminescence element
[Drawing 2]A 1st embodiment of the element structure of this invention
[Drawing 3]A 2nd embodiment of the element structure of this invention
[Drawing 4]A 3rd embodiment of the element structure of this invention
[Drawing 5]A 4th embodiment of the element structure of this invention
[Drawing 6](a) Measurement procedure of the dissolution range of the sample piece by -(c) solubility parameter display
[Explanations of letters or numerals]
10 Positive electrode layer
20 Electron hole transporting bed
40 Luminous layer
41 Dopant
70 Catholyte

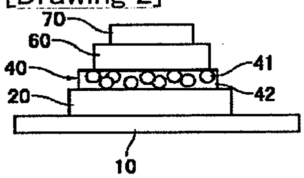
[Translation done.]

DRAWINGS

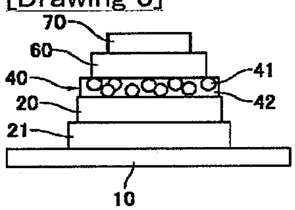
[Drawing 1]



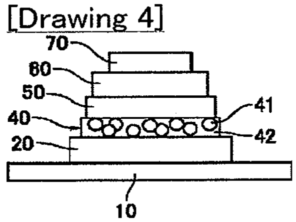
[Drawing 2]



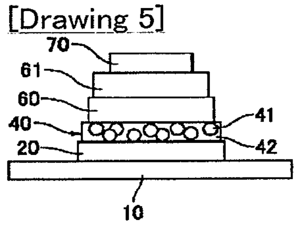
[Drawing 3]



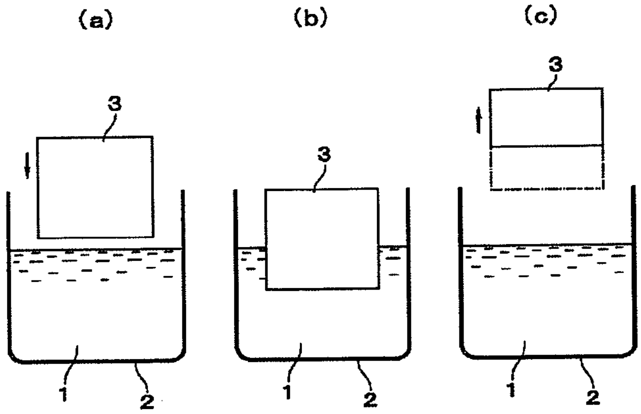
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]